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Global Toxic Footprints

Ten petrochemical companies: more than meets the disclosure

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Executive summary

Toxic pollution can affect the financial performance of petrochemical companies and their investors. Regulations may increase costs, incidents can damage assets and interrupt production and lawsuits or remediation obligations can lead to long-term liabilities.

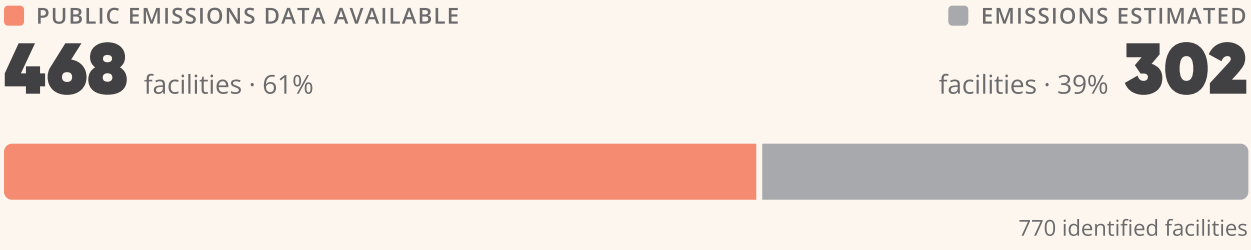
This report builds on Planet Tracker's earlier studies in the US and Europe, by looking at the global operations of ten major petrochemical companies from 2019 to 2023. Most of these companies also produce plastics. We assessed air releases at 770 facilities using two measures: the mass of carcinogenic chemicals and toxicity-weighted releases, which account for differences in chemicals' relative toxicity. These measures help identify priorities for investigating pollution-related financial risks.[a]

The accompanying interactive dashboard allows investors to explore facility-level releases to air, water and land. It also helps users distinguish reported data from estimates and identify reported institutional equity holdings to support engagement.

Investors face substantial gaps in public emissions data

Public emissions data are available for only 468 out of 770 identified facilities (61%). For the other 302 facilities (39%), releases have to be estimated. Even when records exist, reporting rules can leave out important substances. These gaps make it harder for investors to look into which locations and chemicals might trigger additional costs, legal claims, or cleanup liabilities. Estimates help fill in the picture but are not a substitute for company disclosure. Missing public records alone do not prove regulatory non-compliance.

Public emissions data are available for 468 of the 770 identified facilities (61%); emissions for the remaining 302 facilities (39%) are estimated.



Source: Planet Tracker.

a They do not measure financial liabilities or actual exposure or health effects.

Different measures identify different engagement priorities

INEOS, Dow, and BASF make up about 83% of the toxicity-weighted air releases among the ten companies, including estimates. Ethylene oxide dominates their reported toxicity-weighted totals. By contrast, SABIC, LyondellBasell and INEOS rank highest by carcinogenic air-release mass. INEOS is the only company among the top three under both measures.

Most releases come from a small number of facilities. The top three sites make up about 65% of INEOS's, 50% of Dow's, and 55% of BASF's toxicity-weighted air releases, including estimates. These locations are a good place to start reducing pollution.

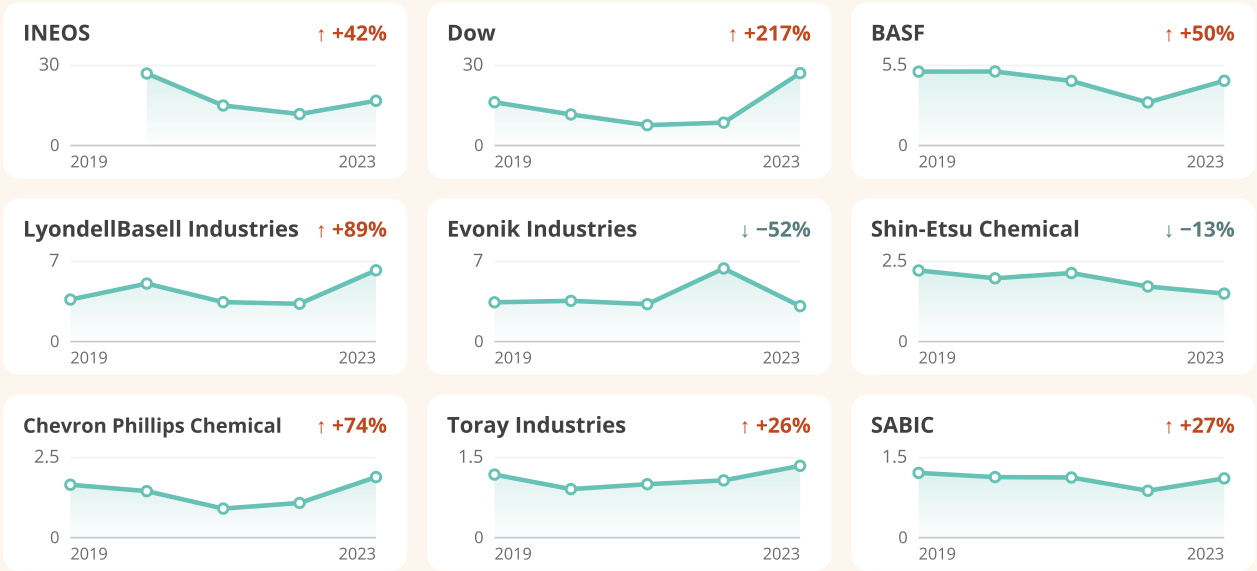
Progress is uneven

Trends differ between companies, and a lower carcinogenic release mass does not always mean lower toxicity-weighted releases. From 2019 to 2023, Dow's carcinogenic air-release mass dropped by 24% but its toxicity-weighted releases increased by 45%.

In 2023, seven out of nine companies saw an increase in toxicity-weighted air-release intensity. But intensity depends on both releases and revenue. INEOS and SABIC had higher intensity even though their total releases were lower because their revenues dropped more (see chart below). Investors should look at whether pollution prevention is lasting or just the result of changes in production, incidents or reporting updates.

Annual toxicity-weighted air-release intensity by company, 2019–2023

Million toxicity-weighted units per USD million revenue, constant 2015 prices



Source: Planet Tracker.

Note: Vertical scales differ between panels to show changes within each company; line heights should not be compared across panels. Intensity reflects both releases and revenue. Braskem is excluded because its modelled intensity does not independently track environmental performance. Arrows show the change in intensity from 2022 to 2023.

INVESTOR CALL TO ACTION

Investors should demand better disclosure and credible reduction plans

Investors should prioritise engagement with companies with the highest toxic releases and press for better disclosure across global operations. Companies should publish consistent annual release data by facility and substance, explain reporting gaps, and report both absolute releases and intensity.

Investors should ask for pollution-reduction plans with time-bound targets, quantified capital and operating expenditure, clear board responsibility, and annual progress updates against a baseline. Companies should explain whether changes in releases reflect pollution prevention, production levels or reporting revisions.

Reviewing these plans alongside regulatory requirements, environmental provisions and legal claims will help investors assess how companies manage current pollution and long-term liabilities. Investors should use the findings to set specific engagement objectives and, where progress is insufficient, consider escalation through shareholder resolutions or votes on director elections, where applicable.

Explore our interactive dashboard and download company engagement sheets

1
Mapping the global toxic footprint

Planet Tracker's earlier research examined toxic emissions from petrochemical plants in the US[1] (Texas and Louisiana) and in Europe (parts of Belgium, the Netherlands and Germany).[2] The US Toxic Footprints study included 225 facilities and 211 chemicals and linked the findings to 6,522 investors holding shares in the companies assessed. The EU Toxic Footprints study found 1,093 facilities responsible for more than 125 million tonnes of chemical discharges and transfers since 2010. These studies and their accompanying dashboards[b] showed how facility-level pollution data can be linked to the companies responsible and to the financial institutions that are invested in them.

This report builds on that work by looking at ten of the leading petrochemical companies: BASF, Braskem, Chevron Phillips Chemical, Dow, Evonik Industries, INEOS, LyondellBasell Industries, SABIC, Shin-Etsu Chemical and Toray Industries. It covers 770 facilities globally and combines the publicly available emissions data for 468 of those facilities with estimates for the remaining 302 to give a more complete picture of the companies' global toxic releases.

This report is concerned with on-site toxic releases to air over the period 2019–2023 and uses two complementary indicators: toxicity-weighted air releases and carcinogenic air-release mass. These indicators allow the relative potential hazard of different chemicals and the amount of carcinogenic chemicals released to be compared. The interactive toolkit contains additional results for releases to air, water and land. Appendix – Data Methodology details the company selection criteria, reporting periods, facility locations, estimation methods, indicator calculations and limitations.

2
How we measure toxic pollution

Chemical emissions data were obtained from the publicly available Pollutant Release and Transfer Registers (PRTRs) for the following countries/regions: US, Canada, Mexico, Chile, EU, UK, Japan and Australia.

We harmonised the chemicals, industry sectors and parent company names across the datasets. There are large differences in the reporting requirements in each country, which makes it very difficult to compare emissions of all chemicals across regions. The main comparisons in the report are therefore of on-site air emissions for 2019–2023 as this is the dataset that provides the most comparable basis for company assessment.

b See Toxic Footprint US: dashboard and Toxic Footprint Europe: dashboard

We use two indicators:

Toxicity-weighted air releases

Release quantities (kilograms) of each chemical multiplied by its available US Environmental Protection Agency (EPA) Risk-Screening Environmental Indicators (RSEI) toxicity weight, including both carcinogenic and non-carcinogenic chemicals.[c]

Carcinogenic air-release mass

Release quantities (kilograms) of chemicals classified as carcinogenic whether or not an RSEI toxicity weight is available.

These indicators cover different sets of chemicals and give a different perspective on the pollution of the company. The accompanying dashboard contains facility level data for reported releases to air, water and land, allowing users to look at other substances, other pathways and other locations beyond the air-based comparisons in this report.

For countries without a publicly available PRTR, we compiled facility information from company websites and supplemented it with extensive AI-assisted internet searches. For companies other than Braskem, we estimated releases at facilities without public PRTR data using the company's average releases per registered facility, calculated separately for each chemical, release medium and year over 2019–2023. Braskem required a separate sector-based estimation method, explained in Section 3.2. Together these estimates extend the assessment to 302 facilities without public PRTR data.

3 The pollution disclosure gap

3.1 Public data provides an incomplete and uneven picture

Missing public data do not, by themselves, establish non-compliance. Indeed, reporting requirements, substance coverage and the availability of accessible public records differ between jurisdictions.

Disclosure levels also vary widely among companies, ranging from 33 to 77% of identified facilities. Thus, a corporate toxic-footprint assessment that relies solely on public PRTR data would produce an incomplete, uneven picture of companies' operations (Table 1).

c This measure indicates relative potential hazard, not actual exposure or health effects. Unlike the RSEI Score, it does not incorporate environmental fate and transport modelling, or population exposure. Understanding RSEI Results | US EPA

TABLE 1

Disclosure coverage differs materially between companies

COMPANY	IDENTIFIED FACILITIES	FACILITIES WITH PUBLIC PRTR DATA	FACILITIES REQUIRING ESTIMATES	PUBLIC DATA COVERAGE
SABIC	51	17	34	33%
Braskem	15	6	9	40%
LyondellBasell Industries	72	35	37	49%
Toray Industries	81	44	37	54%
Shin-Etsu Chemical	69	39	30	57%
Dow	104	63	41	61%
Evonik Industries	72	47	25	65%
BASF	181	122	59	67%
Chevron Phillips Chemical	19	13	6	68%
INEOS	106	82	24	77%
Total	**770**	**468**	**302**	**61%**

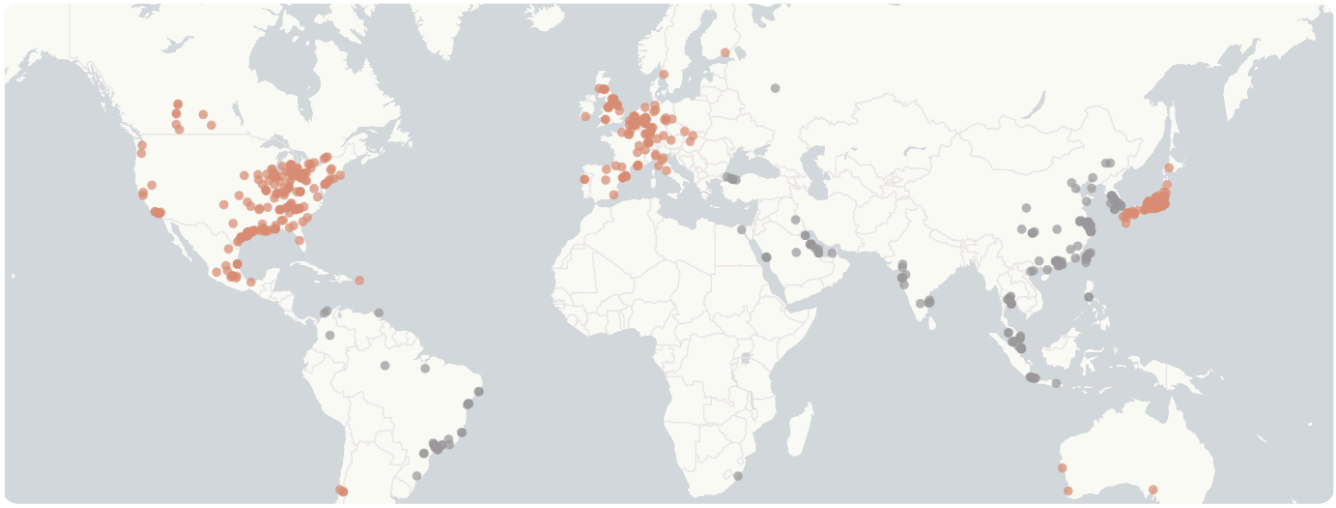
Source: Planet Tracker.

Global map

Public emissions records are concentrated in the US, Europe and Japan, while many identified facilities in China, Saudi Arabia and Brazil require estimates. Figure 1 highlights how the availability of public data varies across the companies' global operations.

FIGURE 1

Global distribution of identified facilities by availability of public PRTR emissions data



Source: Planet Tracker.

Note: Orange dots indicate facilities with public PRTR emissions data; grey dots indicate facilities requiring emissions estimates. The map displays 709 of the 770 identified facilities. Coordinates are unavailable for 61 facilities: two with public PRTR records and 59 requiring emissions estimates. Equal-sized dots indicate locations, not release quantities.

3.2 Estimates extend coverage but cannot replace disclosure

Transparent estimates help with global-level comparability and also with identifying potential priorities, but they cannot replace facility-level disclosures provided by companies. This matters to investors because incomplete data may hide the substances, locations, and facilities that could lead to exposure and liability. Thus, it is important, when interpreting the results, to consider the share of each company's assessed total that is estimated.

The proportion of estimated toxicity-weighted air releases varies substantially between companies, from 24% for INEOS to more than 99.99% for Braskem (Table 2).

TABLE 2

Reliance on estimates varies materially between companies.

Assessment period: 2019-2023

COMPANY	ESTIMATED SHARE OF ASSESSED TOXICITY-WEIGHTED AIR RELEASES
INEOS	24%
Chevron Phillips Chemical	33%
Evonik Industries	38%
BASF	41%
Dow	44%
Shin-Etsu Chemical	45%
Toray Industries	51%
LyondellBasell Industries	55%
SABIC	69%
Braskem	>99.99%

Source: Planet Tracker.

For the nine companies other than Braskem, estimated releases are calculated from the company's average reported releases per facility for each chemical, release medium and year. This approach assumes that reporting facilities are representative; it may therefore not capture differences in production processes, chemical use or pollution controls.

Braskem is treated separately. Although public PRTR data exist for six of its 15 facilities, over 99.99% of its assessed toxicity-weighted air releases are estimated. Its registered facilities were not considered representative of its wider operations, so we used fixed US sector-level chemical-release intensities, scaled by Braskem's revenue, rather than the company-average approach.

Braskem's modelled releases are included in absolute totals and rankings but excluded from intensity rankings and trend comparisons. Because the estimates use fixed sector intensities scaled by revenue, they do not independently track changes in environmental performance. A flat modelled intensity therefore reflects the modelling assumptions, not evidence of stable performance.

3.3 Sense-checking our estimated data against company disclosures

Comparisons with selected company disclosures provide useful checks on the order of magnitude of our results, although differences in scope limit direct comparability (Table 3). Compared with company-disclosed totals, our harmonised dataset allows investors to investigate individual chemicals and facilities by reporting year.

TABLE 3

Comparison with selected company disclosures

COMPANY	YEAR	COMPANY DISCLOSURE	PLANET TRACKER DATASET
Shin-Etsu	2023	PRTR-listed substances released in Japan: 179 t	Japan: 161 t captured
Toray	2022	PRTR-listed air releases: 821 t globally; 256 t in Japan	Japan: 244 t captured; Global: 550 t estimated
BASF	2022	Global heavy-metal releases: 19 t (4 t to air; 15 t to water)	Global: 24.8 t estimated
Evonik	2022	Global heavy-metal releases to water from directly discharging sites: 1.3 t	Global: 1.49 t estimated

Note: Scope differs between company disclosures and the Planet Tracker dataset; figures are not necessarily directly comparable. All quantities are in tonnes (t).

Source: Company disclosures, Planet Tracker.

3.4 Covering every facility does not mean covering every substance

Public emissions data for a facility might not include every substance it releases. This means that even if a site is listed in our dataset, some chemical releases might not be recorded. Estimating emissions for sites without public data does not fix these gaps. The example below shows why having data for all facilities does not necessarily mean we have a complete picture of pollution.

PFAS: what emissions data miss

Public emissions data can leave out substances that matter for regulatory and legal risk, for example PFAS (see Planet Tracker's report, PFAS: From non-stick to stuck in court, which sets out the financial risks linked to PFAS lawsuits and cleanups).

SABIC's Bergen op Zoom facility in the Netherlands is a case in point. Public reports indicated historical discharges of around 51kg of PFBS (a type of PFAS) per year from the facility into the Westerschelde (the estuary where the Scheldt river meets the North Sea)[7]. However, our dataset has no PFAS releases from that facility, since companies are not asked to disclose their PFAS releases to the EU PRTR. In fact, of the ten companies we looked at, our dataset shows only one facility with any PFAS releases: BASF's Freeport site in the US which reported 2.8kg in 2020.[d]

When it comes to chemicals such as PFAS, which are only recently being added to the reporting requirements of some PRTRs, investors should therefore look at the emissions data in conjunction with other sources of evidence such as discharge permits, regulatory findings, contaminated site information and litigation.

d The dataset also records some off-site PFAS transfers for INEOS in the United States. Transfers are outside the scope of the report.

4

Where is toxicity-weighted air pollution most concentrated?

Beyond the issue of data coverage, the choice of indicator also makes a difference to the assessment. To illustrate this, we have looked at the companies in terms of the quantity of carcinogens released to air (in kg) as well as in terms of the toxicity score.

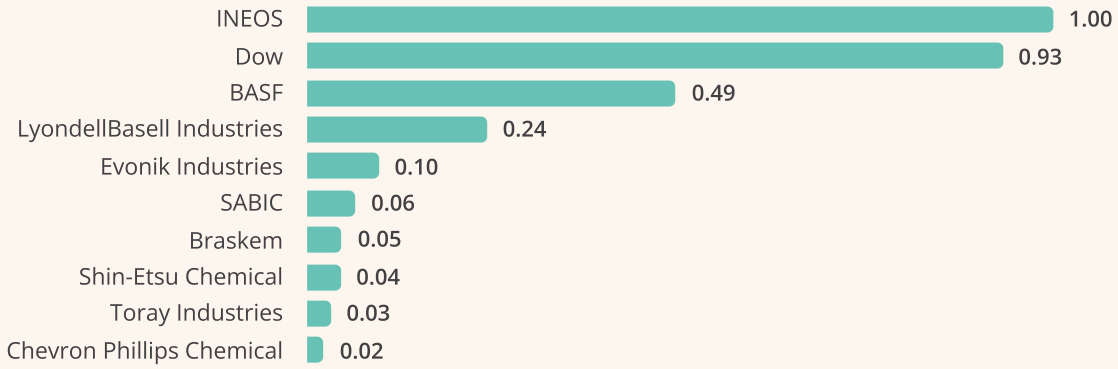
4.1 INEOS, Dow and BASF have the highest toxicity-weighted air releases

Planet Tracker uses toxicity-weighted air releases to quantify the relative potential hazard of toxic chemical emissions.

INEOS, Dow and BASF **together account for 82.9%** of assessed toxicity-weighted air releases across the ten companies over 2019–2023. INEOS is the largest contributor, followed by Dow and BASF. Figure 2 presents company totals on a relative scale, with the highest contributor, INEOS, set to 1.

FIGURE 2

Relative toxicity-weighted air releases by company, 2019–2023 (index: INEOS = 1)



Source: Planet Tracker.

Note: Each company's assessed toxicity-weighted air releases, including estimates, are divided by the highest company total. The index compares relative potential hazard; it does not measure actual exposure or health effects

4.2 Ethylene oxide drives the highest company totals

Ethylene oxide is by far the biggest contributor to the toxicity-weighted air releases for INEOS, Dow and BASF, accounting for 86.3%, 96.1% and 84.3% of their respective reported totals. It is a chemical intermediate used in the manufacture of a range of products including plastics, textiles, detergents and antifreeze. The US EPA classifies it as carcinogenic to humans with long-term inhalation exposure linked to increased risks of cancers of the lymphoid- and blood-forming systems, and breast cancer in women. The other significant contributors are benzene, 1,3-butadiene and acrylonitrile (all of which are also known to be carcinogenic to humans). For diaminotoluene and the cobalt compounds the classification is dependent on the particular chemical form (Table 4).

TABLE 4

Chemicals and companies driving toxicity-weighted air releases

COMPANY	TOP THREE CHEMICALS	COMBINED SHARE OF TOP THREE CHEMICALS
BASF	Ethylene oxide (84.3%); diaminotoluene, mixed isomers (5.7%); cobalt and its compounds (3.2%)	93.2%
Dow	Ethylene oxide (96.1%); 1,3-butadiene (0.9%); benzene (0.8%)	97.8%
INEOS	Ethylene oxide (86.3%); acrylonitrile (3.3%); 1,3-butadiene (2.5%)	92.2%

Source: Planet Tracker.

4.3 A small number of facilities dominate reported releases

Reported toxicity-weighted air releases are very heavily concentrated at a small number of sites. For INEOS, Dow and BASF the three largest contributing sites account for 86.0%, 88.7% and 93.2% of their respective reported totals (Table 5).

TABLE 5

Leading facilities' contributions to reported and assessed company toxicity-weighted air releases, 2019-2023

COMPANY	THREE LARGEST CONTRIBUTING FACILITIES AND THEIR INDIVIDUAL SHARES OF REPORTED COMPANY RELEASES	COMBINED SHARE OF REPORTED COMPANY TOTAL	COMBINED SHARE OF ASSESSED COMPANY TOTAL, INCLUDING ESTIMATES
INEOS	Zwijndrecht (Antwerp), Belgium (44.0%); Bayport EO Plant, Pasadena, US (21.1%); Lavéra, Martigues, France (20.9%)	86.0%	65.0%
Dow	Louisiana Operations, Plaquemine, US (34.1%); St Charles Operations, Hahnville, US (30.5%); Seadrift Plant, Seadrift, US (24.0%)	88.7%	49.9%
BASF	Geismar, US (85.1%); Spartanburg, US (4.9%); BASF TODA America, Battle Creek, US (3.3%)	93.2%	55.3%

Source: Planet Tracker.

These same facilities account for a smaller (though still significant) proportion of the company's total assessed toxicity-weighted air releases when, in the case of facilities without public PRTR data, the estimated releases are included: 65.0% for INEOS, 49.9% for Dow and 55.3% for BASF.

4.4 Targeting the largest contributors could materially reduce company totals

The facility concentration outlined above provides clear priorities for **targeted emissions reductions**. For example, halving the toxicity-weighted air emissions at each company's three largest contributing facilities would reduce INEOS's assessed total by around 33%, BASF's by 28% and Dow's by 25%. These reductions are calculated against the company totals (which include estimates) with all other reported and estimated emissions held constant.

Investors should ask companies to explain the processes and substances responsible for releases at these sites, identify available measures to reduce them, and disclose the associated costs, timelines and targets. This facility-specific engagement should complement company-wide reduction commitments and improved disclosure across facilities, particularly where public emissions data are unavailable.

5

Does company size or the choice of measure change the rankings?

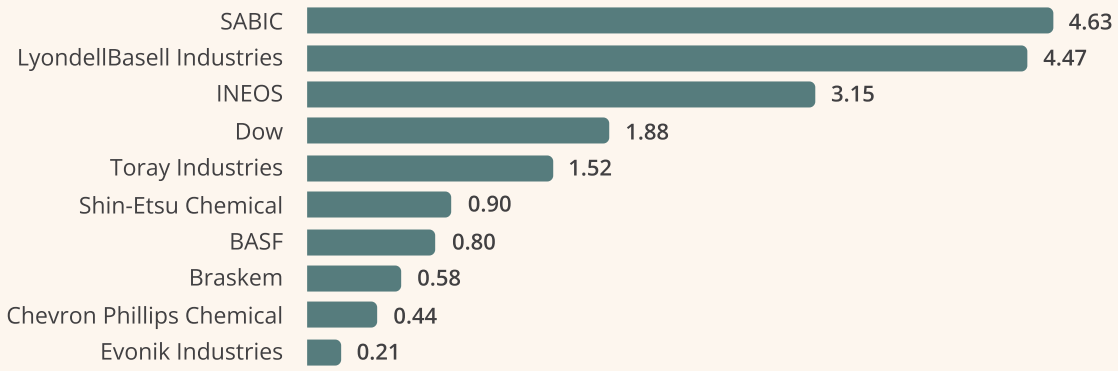
5.1 Using carcinogenic mass as the measure results in a different ranking

SABIC, LyondellBasell and INEOS have the highest carcinogenic air-release mass.

Planet Tracker also looked at the mass of chemicals deemed carcinogenic that the ten companies released into the air.[e] When expressed in kilograms, the carcinogenic air-release mass figures show the total amount of these chemicals discharged from each company's assessed facilities (Figure 3).

FIGURE 3

Carcinogenic air-releases mass by company (million kg), 2019-2023



Source: Planet Tracker.

The rankings differ noticeably between the two measures. SABIC and LyondellBasell rank first and second by carcinogenic air-release mass but sixth and fourth by toxicity-weighted air releases. By contrast, INEOS, Dow and BASF rank first, second and third, respectively, on the toxicity-weighted measure, but only third, fourth and seventh by carcinogenic air-release mass. **INEOS** is the only company that ranks among the top three under both measures.

e Chemicals on the U.S. Toxics Release Inventory (TRI) and the Occupational Safety and Health Act carcinogen list, which include the International Agency for Research on Cancer (IARC) Group 2A and 2B substance classifications.

The measures answer different questions. Carcinogen mass measures the quantity of substances classified as carcinogenic in the assessment, without weighting their relative potency. Toxicity-weighted air release, on the other hand, does account for differences in toxicity across the broader set of assessed toxic chemicals, including carcinogens. The two measures therefore differ in both scope and weighting.

For investors, these differences highlight the importance of examining the chemicals and facilities driving each company's results. SABIC and LyondellBasell stand out for the quantity of carcinogens released, while Dow and BASF rank more highly when toxicity weighting is applied. INEOS ranks highly under both measures.

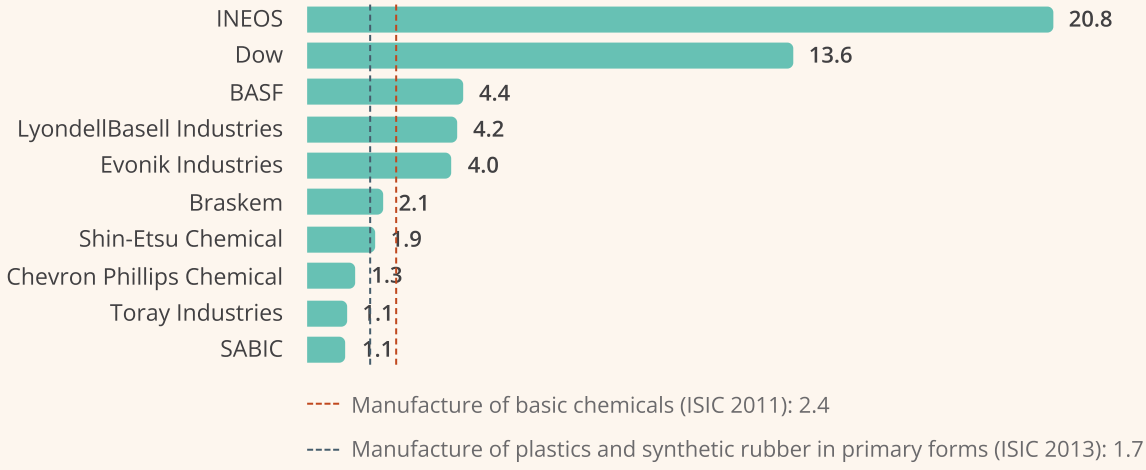
5.2 Adjusting for revenue does not remove the differences between measures

To examine whether company size explains the rankings, we express releases per USD million of company revenue. **INEOS, Dow and BASF remain the top three for toxicity-weighted air-release intensity.** Figure 4 compares the assessed companies with benchmarks for two relevant sectors: the manufacture of basic chemicals and the manufacture of plastics and synthetic rubber in primary forms.

FIGURE 4

Toxicity-weighted air releases per USD million of company revenue, constant 2015 prices, compared with sector benchmarks for manufacture of basic chemicals (ISIC code 2011) and manufacture of plastics and synthetic rubber in primary forms (ISIC code 2013)

Million toxicity-weighted units per USD million revenue



Source: UNIDO, Planet Tracker.

Note: Company intensities use revenue as the denominator; sector benchmarks use UNIDO sector output. Company results cover 2019–2023, except INEOS, which covers 2020–2023.

Revenue alone therefore does not explain the toxicity-weighted ranking. BASF has the highest cumulative revenue of the companies assessed but ranks third for intensity, while SABIC has the third-highest revenue but the lowest intensity (Table 6).

TABLE 6

Toxicity-weighted air-release intensity and cumulative company revenue, period: 2019–2023

COMPANY	TOXICITY-WEIGHTED AIR RELEASES PER USD MILLION OF REVENUE	REVENUE OVER THE PERIOD (USD BN)
INEOS	20.8m	142*
Dow	13.6m	204
BASF	4.4m	337
LyondellBasell	4.2m	171
Evonik	4.0m	70
Shin-Etsu	1.9m	70
Chevron Phillips	1.3m	49
Toray	1.1m	85
SABIC	1.1m	176
Braskem (modelled comparator, not ranked)	2.1m**	65*

Source: Planet Tracker.

*Revenues for INEOS and Braskem are estimated for missing years using averages of available years. Revenue is expressed in constant 2015 US dollars. “m” denotes million toxicity-weighted units, not tonnes. ** Braskem is presented as a modelled comparator and is not ranked because its estimates use a different method.

Adjusting for revenue does not eliminate the differences between the two metrics. SABIC has the highest carcinogenic air release mass per USD million of revenue but the lowest toxicity-weighted air pollution intensity of the nine companies ranked. BASF is the opposite way around: it has the lowest carcinogen mass intensity but the third-highest toxicity-weighted intensity (Figure 5).

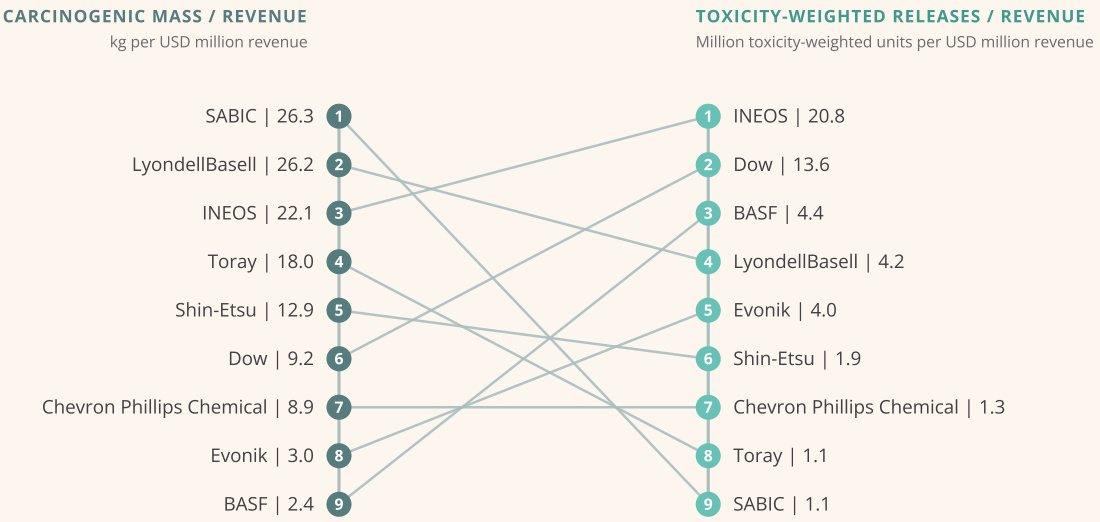
The highest company intensity is about 11 times the lowest for carcinogen mass as against about 19 times for the toxicity-weighted air releases.

For investors, the two measures identify **complementary** engagement priorities even after adjusting for revenue. INEOS and LyondellBasell rank relatively highly under both measures. SABIC and Toray stand out more strongly for carcinogen-mass intensity, while Dow and BASF rank higher when toxicity weighting is applied. Engagement should therefore address the substances and facilities driving both measures, rather than rely on a single ranking.

FIGURE 5

Company rankings vary between carcinogen-mass intensity and toxicity-weighted air-release intensity

Circles show rank: 1 = highest intensity. Lines link the same company across measures, not changes over time.



Source: Planet Tracker.

Note: Revenue is expressed in constant 2015 US dollars. Braskem is excluded because its results use a different, predominantly modelled estimation method.

6 Are companies reducing their toxic releases?

6.1 Who is improving and who is deteriorating?

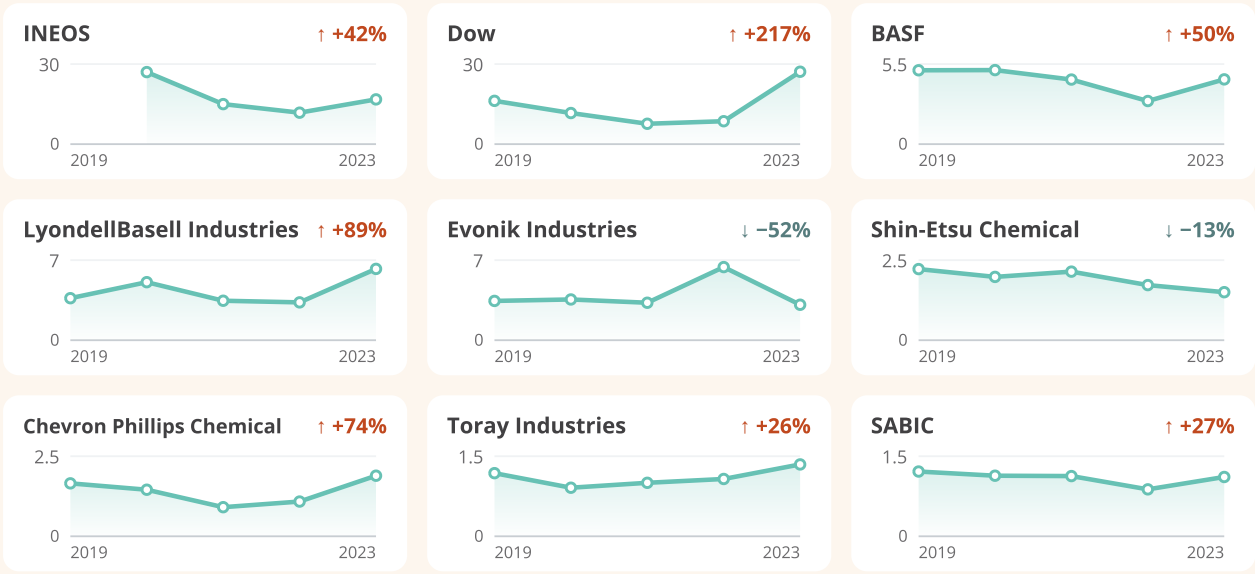
Annual changes in toxicity-weighted air-release intensity reflect both changes in releases and movements in revenue (Figure 6). In 2023, intensity increased at seven out of nine companies compared to 2022. In part this was driven by combined assessed toxicity-weighted air releases increasing by approximately 43% in 2023 across the nine companies, with five companies recording an increase, while four recorded a reduction.

Revenue declines also contributed to rising intensity: INEOS and SABIC had higher intensity even though their absolute releases were lower, because their revenues dropped more sharply.

FIGURE 6

Annual toxicity-weighted air-release intensity by company, 2019–2023

Million toxicity-weighted units per USD million revenue, constant 2015 prices



Source: Planet Tracker.

Note: Vertical scales differ between panels to show changes within each company; line heights should not be compared across panels. Intensity reflects both releases and revenue. Braskem is excluded because its modelled intensity does not independently track environmental performance

Arrows show the change in intensity from 2022 to 2023.

In addition, facility-level events provide context for some of the fluctuations. For example, Dow's sharp increase in intensity in 2023 coincided with increased releases at Plaquemine and a major ethylene oxide incident, while Evonik's 2022 spike coincided with elevated releases at Reserve (for more detail on these see section 6.3).

6.2 Does lower carcinogen mass mean lower toxicity?

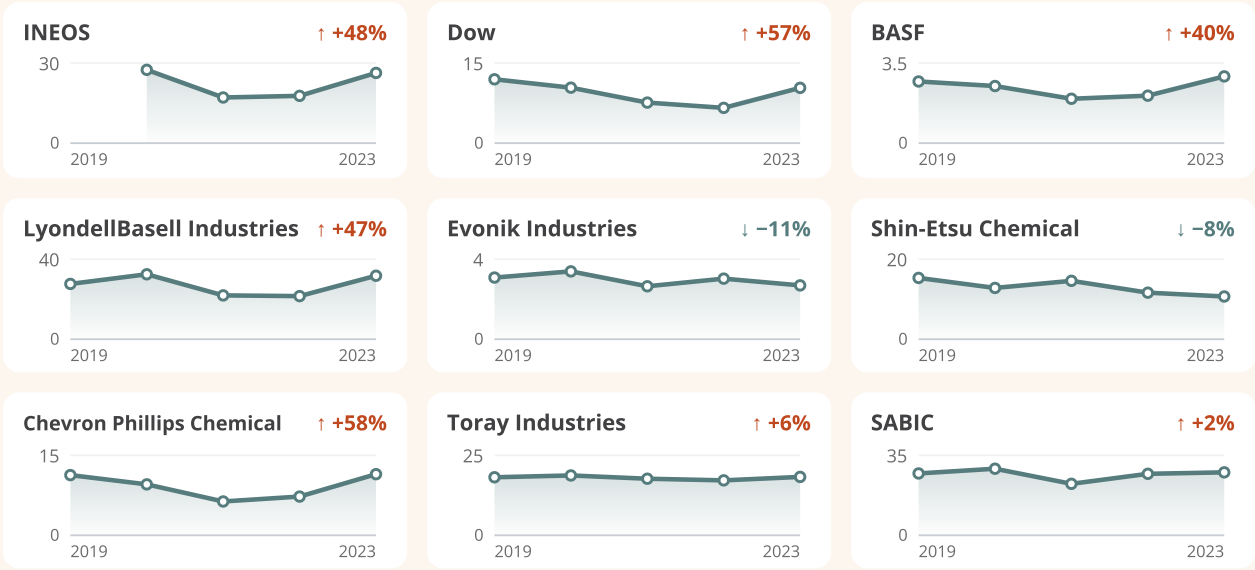
Annual carcinogenic air-release intensity increased at seven of the nine companies in 2023 compared with 2022, with only Evonik and Shin-Etsu recording reductions (Figure 7). Dow, INEOS, LyondellBasell and Chevron Phillips all showed declining intensity between 2020 and 2021, followed by increases in both 2022 and 2023. BASF's intensity also rose in the final two years, exceeding its 2019 level by 2023.

As with toxicity-weighted intensity, these trends reflect both changes in releases and movements in revenue. Rising intensity does not necessarily indicate an increase in absolute releases, nor does falling intensity necessarily demonstrate pollution reduction. The two indicators must therefore be examined alongside absolute release trends.

FIGURE 7

Annual carcinogenic air-release intensity by company, 2019–2023 (kg per USD million revenue, constant 2015 prices)

Kg per USD million revenue, constant 2015 prices



Source: Planet Tracker.

Arrows show the change in intensity from 2022 to 2023.

Changes in carcinogenic air-release mass and toxicity-weighted air releases can move in opposite directions. Between 2019 and 2023 Dow's carcinogenic air-release mass decreased by 24% whereas its toxicity-weighted air releases increased by 45%. BASF was the other way around with its carcinogenic air-release mass up 2% and its toxicity-weighted air releases down 18%. These are the changes between the start and end of the period, not the annual changes.

The measures also vary in terms of how the releases are distributed across the facilities. Across the companies assessed the single largest contributing facility accounts for 8-38% of the company's carcinogenic air release mass when measured by mass, compared to up to 51% for the toxicity weighted air release. **This indicates that in order to reduce carcinogen mass you may well need to take action across a wider range of facilities in addition to the largest contributors.**

6.3 What is driving the changes at individual companies?

Company-wide changes can mask significant differences between sites. A reduction at one of the major contributors can easily outweigh increases at other sites and a single incident can have a significant impact on the overall annual result. Facility-level analysis is therefore key to identifying whether a change is broad-based or is confined to one or more sites.

Dow: Plaquemine's emissions increase coincided with a major incident

Assessed toxicity-weighted air releases at Dow's Plaquemine facility rose from approximately 45 billion units in 2022 to 379 billion in 2023. The increase coincided with explosions and fires in July 2023 that released ethylene oxide, as documented by the US Chemical Safety Board (CSB).[8] The CSB investigation identified failures in equipment checks and safety systems. The incident illustrates why company-wide trends need to be examined alongside events at individual facilities.

INEOS: Large reductions at major contributing facilities

INEOS's assessed toxicity-weighted air releases fell by approximately 63% between 2019 and 2023, from 1,040 billion to 385 billion units, including estimates. Reported releases at Antwerp declined from approximately 444 billion to 107 billion units, while those at Lavéra fell from 219 billion to 33 billion units. Together, these facilities accounted for approximately 64% of INEOS's assessed total in 2019 and 36% in 2023.

The combined reduction at these two sites outweighed a smaller increase across the other reporting facilities, from approximately 135 billion to 148 billion units. The overall decline was therefore concentrated at two major contributors, rather than reflecting reductions across all operations. The reasons for these changes have not been established in this assessment. Investors should ask INEOS to explain the underlying drivers and provide evidence of sustained pollution prevention.

Evonik: End-point comparison does not capture an intervening spike

Evonik's toxicity-weighted air releases fell by 15% from 2019 to 2023, but this end-point comparison hides a significant interim increase. At the Reserve facility, releases rose from about 22 billion units in 2021 to 54 billion in 2022. In 2022, Evonik rechecked its emissions calculations at Reserve and found breaches of permitted limits for ethylene oxide and ethylene glycol. Operations were shut down from November 2022 to February 2023, when a temporary flare was installed. The April 2023 EPA settlement required additional controls, including a thermal oxidiser, a permanent backup flare, and improved leak detection and repair.[9]

For investors, it is essential to identify the drivers behind facility-level changes. Companies should explain whether increases result from incidents, operating conditions, or reporting revisions, and whether reductions reflect genuine pollution prevention or temporary changes in production levels. This distinction is critical to assessing whether improvements are sustainable.

7

How does pollution become financially material?

7.1 Regulation creates compliance costs and uncertainty

Pollution regulation turns chemical releases into financial exposure, whether through emissions controls and monitoring, or changes in how companies operate.

Take the example of **ethylene oxide**, which is the main contributor to toxicity-weighted air releases at INEOS, Dow, and BASF. In 2024, the US Environmental Protection Agency confirmed amendments to air-pollution standards for chemical manufacturing, including to the Hazardous Organic National Emission Standards for Hazardous Air Pollutants, known as the HON rule. The wider regulatory package introduced tighter emissions-control requirements and fenceline monitoring[f] for six air pollutants, including ethylene oxide, benzene and 1,3-butadiene,[10] and was expected to reduce emissions of ethylene oxide and chloroprene from affected facilities by approximately 80%.

The EPA estimated the present value of industry-wide compliance costs at USD 1.8 billion over 2024–2038, equivalent to approximately USD 150 million annually, expressed in 2021 dollars at a 3% discount rate[g]. The EPA also estimated that these compliance costs would amount to less than 1% of the affected large corporations' annual national sales.

However, these industry-level estimates do not establish the costs facing individual companies or facilities. For investors, the relevant questions are where spending is required, how it will be reflected in capital and operating budgets, and whether companies have credible plans to meet the applicable requirements. Companies should not only disclose expected pollution-control expenditure but also distinguish one-off investment from recurring operating and monitoring costs.

To complicate matters, the timing and scope of the required expenditure are still subject to policy uncertainty. A presidential proclamation issued in July 2025 granted listed chemical manufacturing sources two-year extensions beyond their applicable HON compliance deadlines. The EPA also announced that it would reconsider the 2024 requirements.

f Fenceline monitoring measures air pollution at the boundary of an industrial facility. See US EPA, *Technology Market Summit Primer: Fenceline Air Quality Monitoring*

g These figures cover the regulatory package, not ethylene oxide controls alone, and should not be attributed solely to the companies assessed in this report

Another example is **PFAS.** The SABIC PFAS case discussed in Section 3.4 illustrates how tighter discharge limits can require companies to reduce pollution even where the substances concerned are not included in public emissions inventories. Although the case concerns water discharges rather than air releases, it provides another example of regulation driving pollution-control requirements.

7.2 Incidents create costs beyond fines

The Plaquemine incident discussed in Section 6.3 illustrates why penalties alone may not capture an incident's financial impact. Dow reported estimated property damage of USD 43 million[11] while the related Occupational Safety and Health Administration (OSHA) case recorded penalties of only USD 31,250 following settlement[12]. The reported property damage alone was therefore substantially greater than the regulatory penalty (note however that we do not have figures for the total incident cost, or net loss after insurance).

> For investors, the priority is to assess damage to productive assets, operational disruption and corrective expenditure, not simply the size of a fine.

7.3 Litigation can create substantial and persistent liabilities

In January 2023, without admitting liability, Sotera Health announced agreements under which its subsidiary, Sterigenics, would pay USD 408 million to settle more than 870 cases alleging exposure to ethylene oxide released from its Willowbrook sterilisation facility in Illinois.[13] Although Sterigenics is a medical-device sterilisation business, not one of the ten chemical companies assessed in this report, the case demonstrates that ethylene oxide has generated substantial legal claims.

Moreover, liabilities can persist long after the activities that caused them have ceased. For example, Dow's subsidiary Union Carbide reported an asbestos-related liability of USD 726 million as at 30 September 2025, four decades after selling its asbestos mine in 1985[14]. About 74% of this liability relates to expected future claims.

8

Investor holdings and stewardship

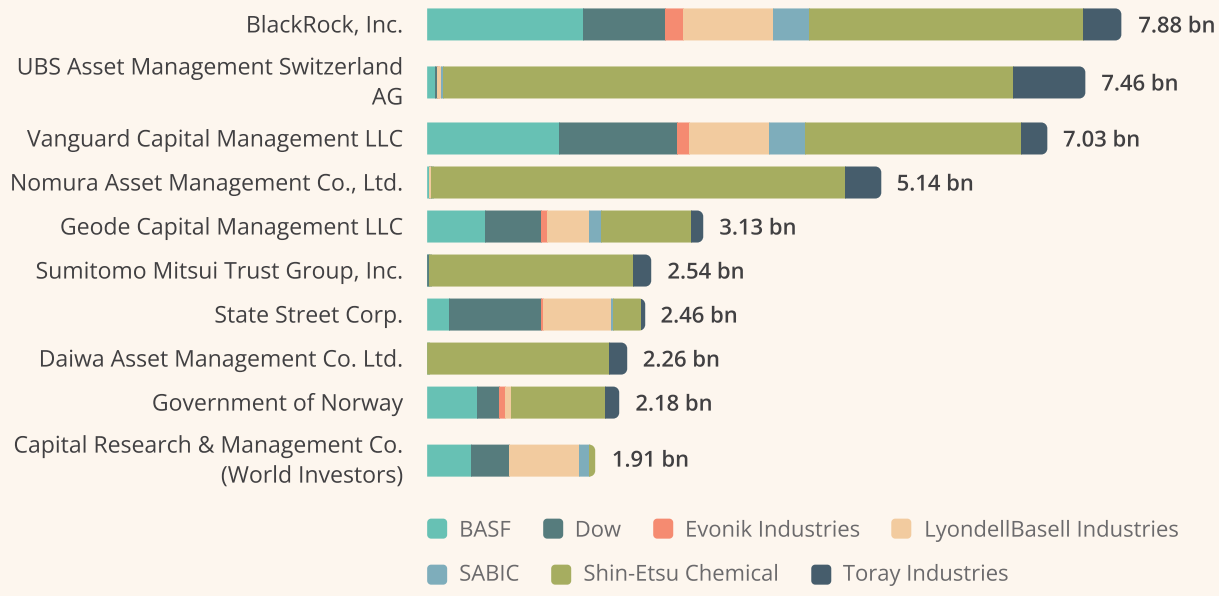
Planet Tracker links facility-level emissions data to the companies responsible and to the financial institutions who are invested in them (based on reported equity holdings as at 17 July 2026).

The holdings dataset identifies the reporting investor, parent group where available, investee company and reported market value of the holding. Linking these holdings to the pollution assessment enables users to identify investments in companies with high carcinogenic air-release mass, high toxicity-weighted air releases or limited public emissions disclosure. Figure 8 shows the ten largest investor groups by aggregate reported equity holdings across the seven companies covered by the holdings analysis.

FIGURE 8

Reported equity holdings of the ten largest investor groups across the seven companies covered by the holdings analysis, as at 17 July 2026

USD billion



Source: FactSet, Planet Tracker.

The holdings analysis covers seven of the ten companies assessed. INEOS and Chevron Phillips Chemical are excluded because they do not have directly-listed equity while no institutional equity holdings data were identified for Braskem in the source used for this assessment (FactSet).

Among the ten investor groups shown, BlackRock and Vanguard have the largest reported holdings in BASF, at USD 1.77 billion and USD 1.50 billion respectively. Vanguard has the largest holding in Dow, at USD 1.33 billion, followed by State Street at USD 1.03 billion and BlackRock at USD 0.92 billion. BlackRock and Vanguard also have the largest holdings among these investor groups in LyondellBasell, at USD 1.02 billion and USD 0.92 billion, and in SABIC, at USD 415 million and USD 407 million. These companies rank second and first respectively for carcinogenic air-release mass and are also priorities for improved emissions disclosure.

By contrast, UBS Asset Management Switzerland and Nomura Asset Management have holdings heavily concentrated in Shin-Etsu Chemical which accounts for approximately 87% and 92% respectively of their reported holdings within this selected dataset.

9

Priorities for investor action

The assessment highlights different engagement priorities for the ten companies. Investors should use the findings to ask for explanations, disclosures, and reduction plans related to the chemicals, facilities, and trends listed below (Table 7).

For all these priorities, investors should ask for board oversight, clear responsibility, and annual reporting of progress against an agreed baseline. Companies should report both absolute releases and intensity, and explain if changes are due to pollution reductions, production changes, or updates to reporting.

Investors should also ask companies to assess opportunities to replace hazardous chemicals or avoid their use through changes in products and processes. Resources such as ChemSec's Marketplace can help identify potential alternatives for further assessment.[15] For example, research has investigated glycidyl methyl ether as an alternative to ethylene oxide for producing ethoxy-free non-ionic surfactants.[16] Separately, Rhodiasolv® RPDE, a dibasic ester solvent, is marketed as an alternative to organic solvents and volatile organic compounds (VOCs) for applications including industrial cleaning, paint stripping and printing inks.[17] Companies should assess whether such approaches are suitable for their specific processes and disclose the expected emissions benefits.

TABLE 7

Priority investor engagement asks arising from the chemical-release assessment / Planet Tracker

ENGAGEMENT TOPIC	COMPANIES FOR TARGETED ENGAGEMENT	WHAT INVESTORS SHOULD ASK
Close disclosure gaps	Braskem LyondellBasell SABIC	Publish annual facility- and substance-level air-release data for sites requiring estimates: Braskem 9/15; LyondellBasell 37/72; SABIC 34/51. Reconcile facility lists and address country-level gaps.
Reduce ethylene oxide releases	BASF Dow INEOS	Set dated reduction plans for Geismar (BASF); Plaquemine, Hahnville and Seadrift (Dow); Antwerp, Bayport and Lavéra (INEOS). Disclose expenditure and assess alternatives to ethylene oxide use.
Focus reductions where releases are concentrated	BASF Dow INEOS	Set site targets for Geismar, Spartanburg and Battle Creek (BASF), and the Dow and INEOS sites above. Report annual reductions, investment and missed milestones.
Explain high pollution intensity	BASF Dow INEOS	Explain high toxicity-weighted air releases per revenue. Identify site-level improvements and set intensity and absolute reduction targets.
Prioritise by local risk, not just totals	All ten	Assess local exposure risks, publish available air-monitoring results and explain how monitoring and both release indicators inform targets.
Explain US air-toxics compliance plans (HON)	BASF Dow INEOS	Confirm covered sites, deadlines and extensions. Disclose capital and recurring costs, required fenceline results and corrective actions.
Disclose substances missing from public records	All ten	Explain air-substance disclosure gaps and publish facility-level data beyond register requirements, where applicable.
Explain liabilities beyond current releases	All ten; Dow incident follow-up; BASF, Dow and INEOS for ethylene oxide	Explain air-related liabilities, claims and provisions. Dow: disclose Plaquemine incident costs and insurance recoveries separately. BASF, Dow and INEOS: assess ethylene oxide legal exposure.

Explore our interactive dashboard to view supporting evidence and download company-specific engagement questions or adaptable questions by priority.

10
Conclusion

Public emissions data provide an incomplete and uneven view of the ten companies' toxic footprints. Only 61% of identified facilities have publicly available emissions data, and even these records may omit important substances. Estimates help fill the gaps, but they cannot replace company disclosures or show exactly what is happening at non-reporting facilities.

Despite these constraints, the assessment finds clear priorities for investor engagement. INEOS, Dow and BASF are the main contributors to overall toxicity-weighted air releases, even after adjusting for revenue. Looking specifically at carcinogenic releases, the investor engagement priorities become SABIC, LyondellBasell and INEOS. Individual company release trends vary, and changes at individual facilities can have a big impact on overall totals.

For investors, the job is twofold: push for reductions in the chemicals and at the facilities already identified as major contributors, and press for disclosure that fills the gaps preventing full assessment of global operations. Better disclosure is also needed to be able to assess whether companies are making lasting pollution reductions and managing related financial risks.

Appendix – Data Methodology

Company selection

We selected ten major petrochemical companies, most of which also produce plastics, to provide broad geographic coverage and a mix of facilities with and without publicly available Pollutant Release and Transfer Register (PRTR) data. This allows the assessment to examine both reported releases and the gaps where estimates are needed. The companies form an initial, non-representative sample; the approach can be extended to additional companies and other industries.

Data sources

Chemical release data were collected from the publicly available Pollutant Release and Transfer Registers (PRTRs) of eight countries and regions:

- United States (EPA Toxics Release Inventory, TRI)[18]
- Canada (National Pollutant Release Inventory, NPRI)[19]
- Mexico (Registro de Emisiones y Transferencia de Contaminantes, RETC)[20]
- Chile (Registro de Emisiones y Transferencia de Contaminantes, RETC)[21]
- European Union (EEA Industrial Emissions Portal, E-PRTR)[22]
- United Kingdom (Pollutant Release and Transfer Registry, PRTR)[23]
- Japan (PRTR)[24]
- Australia (National Pollutant Inventory, NPI)[25]

Each register reports, by facility and year, the quantities of listed substances released to air, water and land, or transferred off-site. Coverage starts between the 1990s and the mid-2000s, depending on the register, and runs to 2023–2024.

We combined these registers with four other sources:

- Toxicity: the US EPA's Risk-Screening Environmental Indicators (RSEI)[26] toxicity weights, and the USEtox model's human-health (DALY) and freshwater ecotoxicity factors[27].
- Company identity: the Global Legal Entity Identifier Foundation (GLEIF)[28] register of legal entities and their parent companies.

- Company revenue: FactSet[29], supplemented with published financial statements for INEOS[30], Chevron Phillips Chemical[31] and Bloomberg[32] data for Braskem.
- Industrial output by sector: UNIDO INDSTAT[33].

Processing

The registers were harmonised in five steps:

- Common format. Each register was converted to a common structure of one record per facility, year, substance and medium, with all quantities expressed in kilograms.
- Chemicals. Substance names were mapped to a single English name and CAS number per chemical. Metal entries ("and its compounds") were treated consistently. Each substance was classified (toxic chemical, greenhouse gas, criteria air pollutant, nutrient) and assigned its toxicity scores.
- Sectors. National industry codes (NAICS, NACE, SCIAN, ANZSIC and the Japanese register's own codes) were mapped to the international ISIC Rev. 4 classification using official concordance tables[34].
- Parent companies. Facilities were attributed to parent companies by matching facility and owner names against curated name patterns for each company, supported by GLEIF parent relationships and checked manually. Where a register records ownership year by year, a facility is counted for a company only in the years it owned it. Some registers only record the most recent owner for each facility.
- Quality control. Implausibly large values were flagged and excluded from the scored dataset. A value was flagged when it was >1000 times the interquartile range of the same chemical at comparable facilities in the same sector, or >100 times the interquartile range of the facility's own history. Totals were checked against EPA's published TRI figures and, where companies publish them, against their own emissions disclosures.

Comparability and scope

Reporting requirements differ widely between registers, which limits how far emissions of the same chemical can be compared across regions:

- Substance lists: US TRI covers 844 chemicals and Japan 515, compared with 200 in Mexico and 94 in the EU and UK. EU and UK include GHG but do not list 1,3-butadiene, formaldehyde, acrylonitrile and styrene, all major petrochemical carcinogens or suspected carcinogens.

- Thresholds: EU and UK record benzene, vinyl chloride, ethylene oxide, 1,2-dichloroethane and dichloromethane to air only above 1 tonne per facility per year. For ethylene oxide, among the most potent air carcinogens, 85% of US emitters release less than 1 t/yr. This means that if the US applied EU thresholds they would miss 23% of their reported mass of ethylene oxide air releases.

To score each company fairly in this **report,** given their different geographical footprints and thus their different PRTR reporting requirements, we use a filtered dataset:

- 2019–2023;
- on-site releases to air only;
- toxic emissions only, defined as a chemical classified as a carcinogen when analysing pollution mass, or a chemical with an RSEI hazard toxicity score from the US EPA when analysing RSEI. This means that in the RSEI scores we include some chemicals that are not labelled as carcinogenic but still have a RSEI toxicity score.

Results are normalized by company revenue at constant 2015 US dollars, so that companies of different size can be compared.

For INEOS, absolute release totals and absolute release trends cover 2019–2023. Revenue-adjusted comparisons and intensity trends cover 2020–2023 because comparable revenue data were not available for 2019.

The **dashboard** that accompanies this report, by contrast, includes all reported chemicals released to air, land and water. It therefore also contains, for example, greenhouse gases in the EU register and deep-well injection of liquid waste in the US. These figures are not directly comparable across registers.

Facilities outside PRTR coverage

Many production sites are in countries without a publicly available PRTR, such as China, Saudi Arabia, Brazil, India and South Korea. For these countries we compiled each company's production sites from its own website and supplemented them with extensive AI-assisted internet searches. The resulting list was checked for duplicates and limited to production sites. In total it comprises 302 facilities.

For each of these facilities, we estimate releases of each chemical to each environmental medium using the parent company's average per registered facility over 2019–2023, across all PRTRs. The results are presented in aggregate.

TABLE 8

Chemical coverage by PRTR, 2019-2023

PRTR NAME	COUNT CHEMICALS REPORTED, IN SCOPE TOXIC TO AIR	COUNT CHEMICALS REPORTED, IN SCOPE TOXIC	COUNT CHEMICALS REPORTED (ALL MEDIA, ALL CHEMICALS, RELEASES AND TRANSFERS)	COUNT CHEMICALS THEORETICALLY IN PRTR, FOR ALL COMPANIES ALL YEARS AS OF 2026 REQUIREMENTS
US TRI	188	198	209	844
JAP PRTR	84	94	145	515
CAN NPRI	33	33	54	491
EU PRTR	19	39	54	94
CHL RETC	6	6	32	121
GBR PRTR	9	25	39	94
AUS NPI	26	26	35	93
MEX RETC	7	12	17	200

Note: Number of Chemicals in the dataset, for the years considered for our analysis: 2019-2023. Data for last column from US TRI,[26] JAP PRTR,[24] CAN NPRI,[19] EU E-PRTR,[22] CHL RETC,[21] GBR PRTR,[23] AUS NPI,[25] MEX RETC[20]

For each company, we report the proportion of its total chemical-release mass and toxicity-weighted score attributable to these estimates.

Braskem's emissions are almost all from sites with no usable register data, mostly in Brazil. The default method (copy the company's average registered site emissions onto each unregistered site) therefore gave Braskem a carcinogen score of zero. We therefore replaced it with a sector-intensity estimate built on UNIDO output data. For each ISIC sector, we took the US TRI air releases of each chemical and divided them by UNIDO's gross output for that US sector. We then scaled the kg released per dollar of sector output by Braskem's revenue split equally across all of its facilities. Each site's estimate is therefore its sector intensity × its revenue share. Giving each site the average US facility emissions in its sector would significantly underestimate Braskem's emissions since Braskem's complexes are much larger than an average US facility, so we used revenue instead.

To the best of our knowledge this has not been attempted before. The estimates should be read as a first, rough approximation of each company's global toxic footprint. They do not reflect what each site actually produces, so they could either overstate or understate a company's emissions.

Limitations of DALYs for this assessment

Planet Tracker also calculates disability-adjusted life years (DALYs) from the USEtox model to offer an additional viewpoint on potential health effects related to chemical emissions. One DALY represents the loss of one year of full health, combining premature mortality and time lived with illness or disability.[43]

Caveats:

For these largely petrochemical companies, the DALY measure is dominated by metals, which make up little of what they release. In practice it ranks a handful of sites outside their petrochemical core: legacy mercury-cell chlor-alkali plants, a silicon smelter, a catalyst maker and a refinery. These typically account for well over half of a company's DALY score but under 1% of its tonnes. The organic chemicals that dominate petrochemical emissions, including carcinogens such as benzene, butadiene and ethylene oxide, score so low in USEtox that they barely register.

In our tests, rankings by DALY were largely unrelated to rankings by tonnes or by carcinogens. We therefore report DALYs only as a supplementary measure and base company scores on carcinogens and RSEI-weighted releases to air.

Many chemicals in the PRTRs do not have a DALY factor in the USEtox model. Out of 209 chemicals with reported releases in the United States in 2019-2023, for the 10 companies analysed, only 124 (59%) had a DALY factor. For Japan, only 57 of 145 chemicals (39%), in EU only 26 out of 54 chemicals (48%), and the other PRTRs are all between 34%-71%.

INEOS has the highest estimated DALYs among the ten companies at 3,388, followed by Evonik Industries at 989 and BASF at 850. Again, these figures are absolute values, with SABIC fourth at 617 and Dow fifth at 613.

In terms of countries, the US (39%), EU (47%), and UK (10%) make up the bulk of DALYs among the 10 companies (9).

For more details, refer to the accompanying **dashboard**, which shows company-level results, DALY estimates for discharges to water and land, and details on substances classified as persistent, bioaccumulative, and toxic (PBT).

USEtox human-health factors (DALYs) weight a kilogram of metal far more heavily than a kilogram of organic chemical. Mercury released to air scores about 3.6 DALY per kg, roughly a million times benzene and half a million times ethylene oxide.

FIGURE 9

PRTR DALYs share for the companies analysed



Source: Planet Tracker.

USEtox itself classes its metal factors as interim because metal speciation and fate are uncertain. Its factors also score fast-degrading organics such as butadiene and ethylene oxide very low, the opposite of the EPA's RSEI weights, where ethylene oxide is among the most heavily weighted chemicals.

Other limitations

- Reporting thresholds mean that small releases, and some substances, are missing from every register.
- Joint ventures are attributed in full to the company that operates or names them.
- The US and EU registers show a facility's current owner for all past years, so historical emissions may be assigned to today's owner.
- Although we did our best to capture most facilities owned by each company in each PRTR, our methodology might have missed some facilities, or misattributed some facilities to the wrong parent company, especially if they recently changed ownership

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Planet Tracker is an independent financial think tank working to align capital markets with planetary boundaries. Through data-driven and investigative research, we assess the financial risks and opportunities arising from natural capital degradation and the transition to a nature-positive economy. Our work focuses on key global value chains across food, land and ocean systems, helping investors, policymakers and companies understand nature-related risks, challenge corporate behaviours, improve capital allocation and support more sustainable economic outcomes.

PLASTICS TRACKER

The goal of Plastics Tracker is to stem the flow of environmentally damaging plastics and related-products that are creating global waste and health issues by transparently mapping capital flows and influence in the sector starting from resins production through to product-use. By illuminating risks related to natural capital degradation and depletion, investors, lenders and corporate interests across the economy will be enabled to create more sustainable plastics products.

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